Horse Research Needs in the Southern Region

Prepared by a Joint Force of the Southern Region Agricultural Experiment Stations and United States Department of Agriculture research scientists with counsel from Horse Industry representatives . . . . . March 1975

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INTRODUCTION

The State Agricultural Experiment Stations of the Southern Region and the United States Department of Agriculture in a continuing effort to identify priority research needs and coordinate research planning activated a regional Horse Research Task Force in June 1974. An Executive Committee organized the gathering of information and formal drafting of a Task Force Report on the Horse Research Needs in the Southern Region. In addition specific subject matter input was provided by 39 individuals representing a broad cross section of research, education and industry.

This report attempts to evaluate the scope of the horse industry in the South, examines current needs and projected trends, identifies researchable problems, and summarizes potential benefits. It should be recognized that the content is largely a judgment of the Task Force participants at the time of preparation and the report is intended to serve as a guide for scientists and administrators as to what needs to be done and why. It is hoped that continual monitoring of the industry to identify new areas of research will follow and that thorough study for coordinating implementation will result.

CHARACTERISTICS OF THE REGION AS THEY INFLUENCE THE HORSE INDUSTRY

The Southern Region[1] offers a diverse set of conditions including climate, water, soil type and population density, all of which have an influence on the horse industry. Although the region varies from the semi-desert areas of its western section to both temperate and sub-tropical areas in the north and southeast, the entire region offers weather which permits year-round, or semi-year-round, use of the horse. These same conditions influence the management systems in use in the region.

[1]The Southern Region is composed of the states of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and the territories of Puerto Rico and the Virgin Islands. Tables and figures do not include data on Puerto Rico and the Virgin Islands since comparable statistics from those locations were not available to the committee.

THE INDUSTRY

The horse industry includes the commercial breeding farm and the one-horse backyard paddock; the 5-million-dollar Thoroughbred stallion and the $50 grade pony; the race horse owner and the 4-H club member. Nowhere else can one find such a diverse collection of individuals and enterprises with a common interest.

In 1920, the horse and mule population of the Southern Region was about 7.9 million (Table 1); by 1959 when the horse census by the U.S. Department of Agriculture was discontinued, the population had declined to about 1.4 million. The horse census was discontinued on the basis that the internal combustion engine had rendered the horse obsolete for either military or farming purposes. Unrecognized, however, was the fact that the horse was assuming an important role in the recreation industry.

Table 1. Horse and Mule Population 1920-59.[1]

	1920	1959
Alabama	426,600	93,203
Arkansas	574,603	76,644
Florida	80,616	26,543
Georgia	506,854	70,509
Kentucky	675,299	144,663
Louisiana	358,871	87,392
Mississippi	523,068	141,199
North Carolina	428,005	145,101
Oklahoma	1,075,078	90,023
South Carolina	297,681	68,407
Tennessee	670,431	139,380
Texas	1,837,294	237,615
Virginia	409,295	84,293
Southern Region	7,863,695	1,404,972

[1]U.S. Census of Agriculture.

Throughout the 'sixties the horse industry increased dramatically. Horse numbers, owners and activities all responded to the nation's increased emphasis on leisure time activities. Although accurate counts on the growth are not available, the increase in the numbers of American Quarter

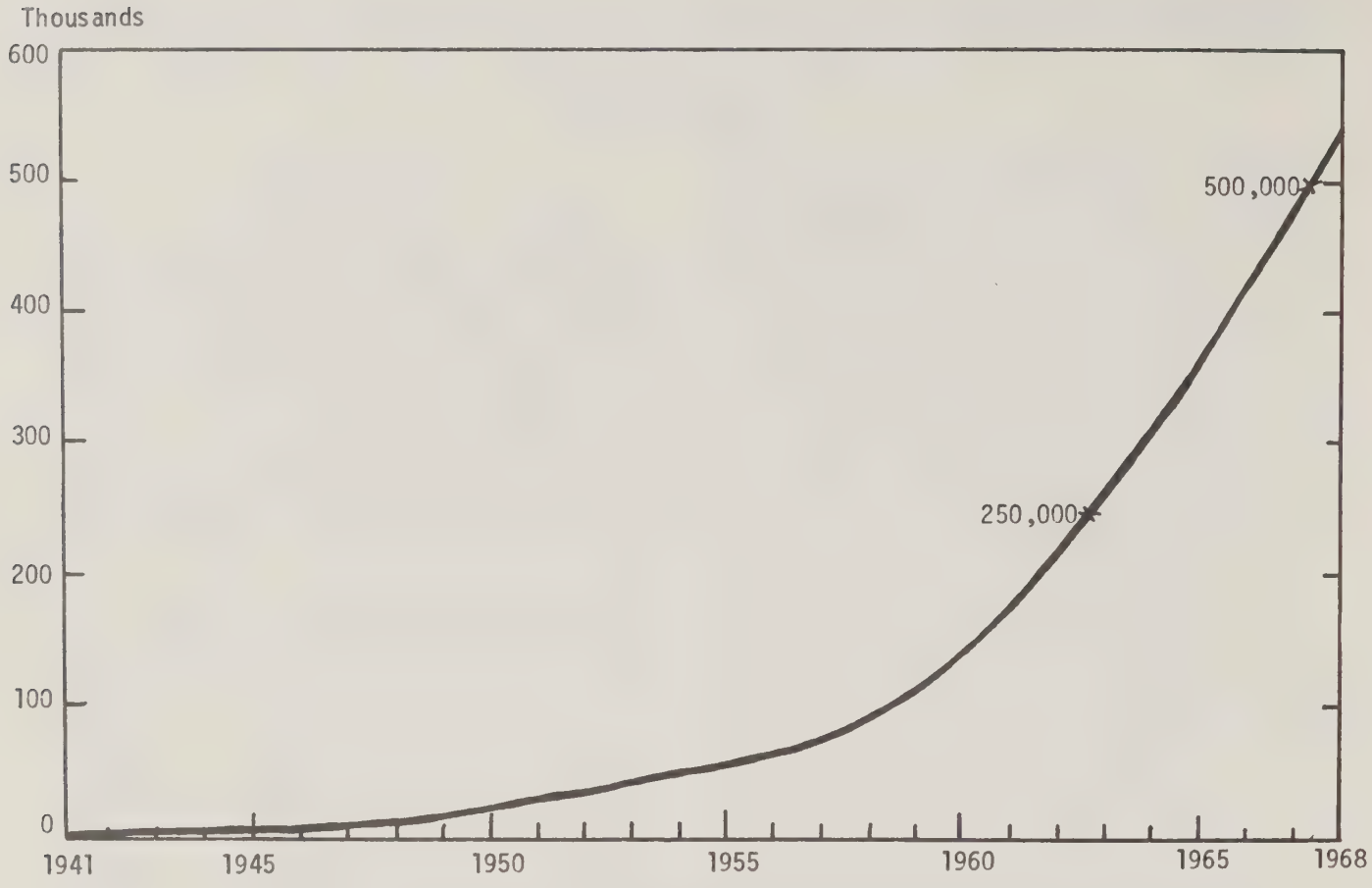


Fig. 1.—Growth of Quarter Horse registration in the United States, 1941-68.

In 1971, the threat of Venezuelan equine encephalomyelitis forced the states in the Southern Region to undertake an emergency vaccination program. Financed by the federal government, the records from this program provided the first accurate appraisal of the horse population in this area. Table 2 summarizes this program for the Southern Region and indicates that the Region had about 2,330,000 horses in 1971.

The rapid growth of the horse industry in the 'sixties was followed by a steady expansion in the early 'seventies. Figure 2 shows the registration inventories for six breeds from 1969 to 1973. These breeds achieved an average annual inventory increase of 10.9% during this period. Quarter Horse registration for each of the states in the Southern Region is shown in Table 3.

Owing to the large variety of different types of activities which are a part of the industry an accurate appraisal of the industry must be done in segments.

Racing—Horse racing is the number one spectator sport in the country. About 75 million persons attended horse race tracks in 1973. Thoroughbred racing is increasing at a rate of 4.4% annually (Fig. 3); however, attendance at some tracks is down. Quarter Horse racing is showing a major increase in popularity, and the annual increase in the number of races offered has been increasing more than 10% each year. Direct taxes on racing provided $533,500,015 to 30 states in 1973 (Table 4). The Southern Region had four states with parimutuel horse racing; Arkansas, Florida, Kentucky and Louisiana. These states reported a total of $38,188,461 income from parimutuel taxes on Thoroughbred races in 1973 (Table 5).

Other Performance Events and Shows—Horse shows have become a popular family weekend activity. Horsemen in the Southern Region can find shows available within easy driving distance every weekend. Adult and youth shows increased

Table 2. Estimated Horse Population for the Southern Region.

	No. Horses Vaccinated, 1971[1]	Estimated % Horses Vaccinated[1]	Estimated Population 1971[1]	Estimated Population 1974[2]
Alabama	122,343	95	129,000	149,334
Arkansas	126,005	98	128,000	148,176
Florida	129,215	89	145,000	167,856
Georgia	105,002	98	107,000	123,866
Kentucky	157,460	93	170,000	196,796
Louisiana	140,812	94	150,000	173,644
Mississippi	145,099	97	149,000	172,486
North Carolina	119,149	92	129,000	149,334
Oklahoma	227,054	99	230,000	266,254
South Carolina	64,356	92	70,000	81,034
Tennessee	179,297	99	180,000	208,372
Texas	574,110	92	625,000	723,516
Virginia	111,989	95	118,000	136,600
Total	2,198,891		2,330,000	2,697,268

[1]"Origin and Spread of Venezuelan Equine Encephalomyelitis"—USDA Bulletin 91-10.
[2]Growth rate from 1971 to 1974 estimated at 5% per year for each state.

steadily from 1969 to 1973 (Fig. 4), and continued expansion is expected. Other competitive events such as rodeos and competitive trail rides are also increasing in both numbers and popularity.

Pleasure Horses—Many horse owners have horses strictly for pleasure riding. Designated trails on private and public land are used regularly by an increasing group of enthusiasts. Limited trail facilities near metropolitan areas restrict many riders to riding rings and roadway berms.

Although many segments of the industry have grown at rates of 10 to 15% a year, it is estimated that the horse population grew at a rate of 5% a year from 1971 to 1974. Thus, the 1974 horse population in the Southern Region would, therefore, total 2,697,268. This is 33.7% of the current estimate of 8 million horses in the United States.

Based on a number of independent surveys, the average horse owner owns 2.5 horses and the average horse-owning family owns 4.5 to 5.5 horses. The Southern Region, therefore, has about 1,000,000 horse owners and 500,000 horse-owning families. The Region includes Kentucky and Florida, the second and third largest Thoroughbred producing states and Texas and Oklahoma, the first and third largest American Quarter Horse producers.

Horses are becoming increasingly important as a source of constructive youth activities. Horse projects are the most popular 4-H club project, with 126,567 completed in the Southern Region and 326,225 nationwide in 1973. However, many breed associations also have active youth programs, and it is estimated by the National Horse and Pony Youth Activities Council that 500,000 youths participated in all youth horse activities in 1973.

The horse industry has a significant economic impact on the Southern Region. At an average value of $500 a horse, Southern Region horsemen have an investment exceeding 1.3 billion dollars in animals. Based on a recent Quarter Horse Journal survey, these horses require more than $700,000,000 for feed, $250,000,000 for health care and result in the purchase of $397,000,000 worth of tack, riding apparel, etc. Thus, the horse industry in the Southern Region is a multibillion-dollar business.

The size of the horse industry and the magnitude of its economic impact provide a stark contrast to the amount of information available to the horseman on the major factors controlling the viability and usefulness of his animals. Novice and professional horsemen alike find a dearth of information available on which to base decisions regarding health programs, feeding, breeding and training. Research and information dissemination (extension) programs are essential for the viability of the industry.

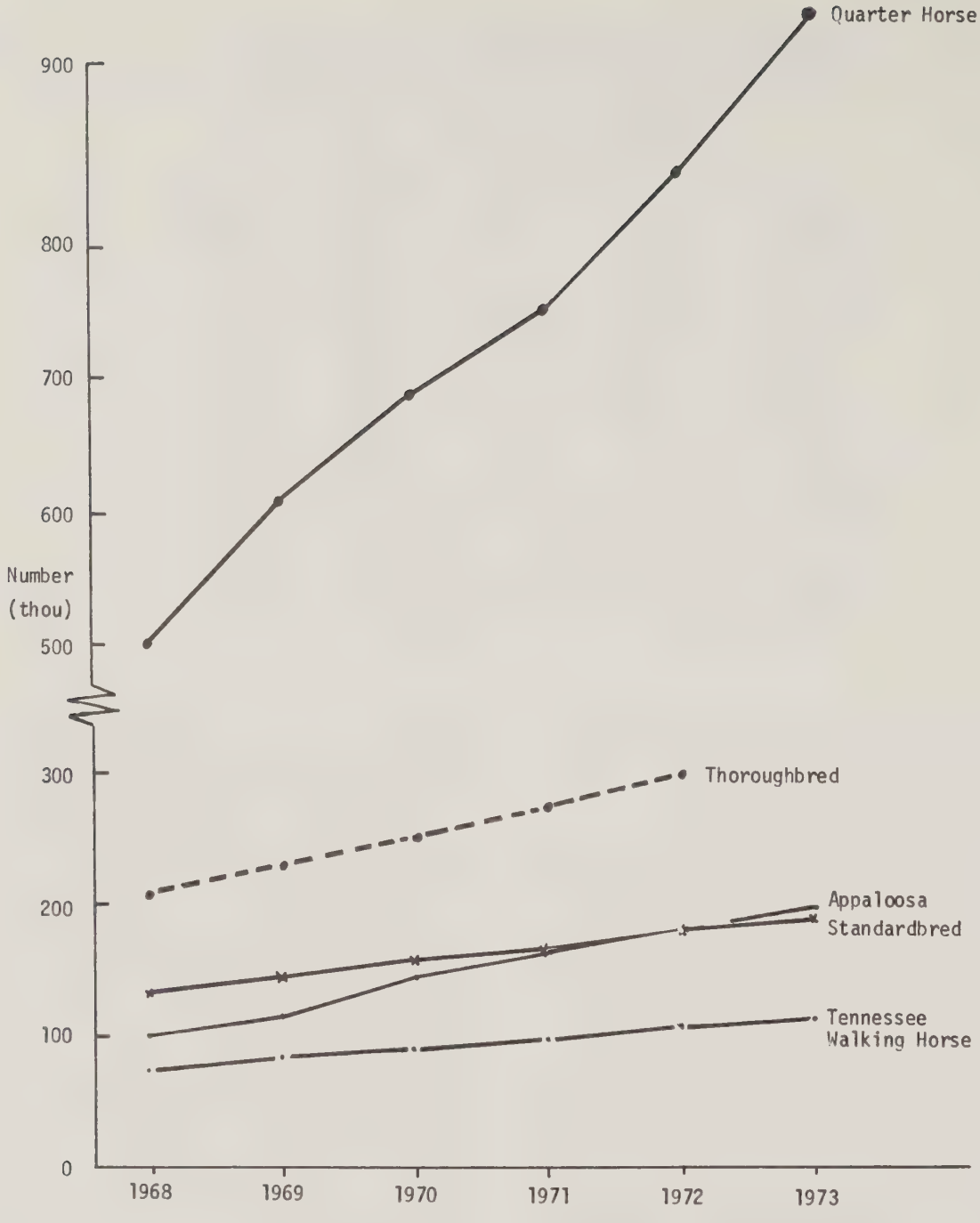


Fig. 2.—Breed registration inventories (1968-73). Source: Respective registries.

(Fig. 2. Data: Registration Inventory, 1968-73.)

	1968	1969	1970	1971	1972	1973
American Quarter Horse	500,000	606,974	687,649	752,737	854,787	931,112
Appaloosa	100,000	114,112	142,812	160,820	178,206	196,625
Arabian	45,000					
Palomino	23,000	26,711	28,863	31,916	35,278	39,609
Standardbred	132,500	144,351	156,332	167,986	179,828	191,221
Tennessee Walking Horse	75,000	83,654	91,668	99,842	107,382	114,631
Thoroughbred	207,000	229,202	250,219	273,614	296,923	

Source: Respective registration departments.

Table 3. Quarter Horse Registration in Southern Region 1969-73.[1]

	1969	1970	1971	1972	1973	Percent Increase, 1969-73	Percent Average Yearly Increase
Alabama	5,040	6,108 (17.5)[2]	6,856 (10.9)	8,154 (15.9)	9,066 (10.1)	80	13.6
Arkansas	10,385	11,805 (12.0)	13,006 (9.2)	14,787 (12.0)	15,978 (7.5)	54	10.2
Florida	11,169	13,358 (16.4)	15,261 (12.5)	18,162 (16.0)	20,222 (10.2)	81	13.8
Georgia	5,830	7,014 (16.9)	7,869 (10.9)	9,356 (15.9)	10,531 (11.2)	81	13.7
Kentucky	2,738	3,503 (21.8)	4,120 (15.0)	5,090 (19.1)	5,916 (13.9)	116	17.4
Louisiana	16,042	18,084 (11.3)	20.091 (10.0)	23,028 (12.8)	24,782 (7.1)	54	10.3
Mississippi	6,230	7,479 (16.7)	8,537 (12.4)	10.018 (14.8)	10,963 (8.6)	76	13.1
North Carolina	3,330	4,171 (20.2)	4,878 (14.5)	6,083 (19.8)	6,950 (12.5)	109	16.8
Oklahoma	44,540	49,956 (10.8)	53,855 (7.2)	59,991 (10.2)	64,317 (6.7)	44	8.7
South Carolina	1,875	2,261 (17.1)	2,506 (9.8)	2,960 (15.3)	3,490 (15.2)	86	14.4
Tennessee	4,168	5,239 (20.4)	6,114 (14.3)	7,476 (18.2)	8,483 (11.9)	104	16.2
Texas	123,280	135,614 (9.1)	145,231 (6.6)	158,741 (8.5)	169,283 (6.2)	37	7.6
Virginia	2,300	2,795 (17.7)	3,377 (17.2)	4,192 (19.4)	4,865 (13.8)	112	17.0
Southern Region	236,927	267,387 (11.4)	291,701 (8.3)	328,038 (11.1)	354,846 (7.6)	50	9.6
U. S. Total	606,974	704,159 (13.8)	752,737 (6.5)	854,787 (11.9)	931,112 (8.2)	53	10.1

[1] *Southern Horseman,* April 1970; June 1971; April 1974.
[2] Percent increase from previous year.

Table 4. Horse Racing Statistics for the U.S. for 1973.[1]

	Thoroughbred	Harness	Quarter Horse	Mixed	Total
Days of racing	5,272	4,970	398	1,139	11,779
Number of races	54,436	49,237	6,644	3,280	113,597
Attendance	43,051,609	26,423,132	1,538,371	3,669,604	74,682,716
Revenue to states	$339,119,933	179,876,058	7,366,654	7,137,370	533,500,015

[1] *The Thoroughbred Record,* July 1974.

Table. 5. Thoroughbred Racing—Attendance and Direct Income by States (1973).[1]

	No. Days of Racing	Attendance	Total Revenue to the State
Arkansas	50	686,565	$ 4,469,437
Florida	326	2,892,964	20,831,546
Kentucky	246	1,787,167	7,157,963
Louisiana	207	1,448,419	5,729,515
Total Southern Region	829	6,815,115	$38,188,461
Total U. S.	5,272	43,051,609	339,119,933

[1] *The Thoroughbred Record,* July 1974.

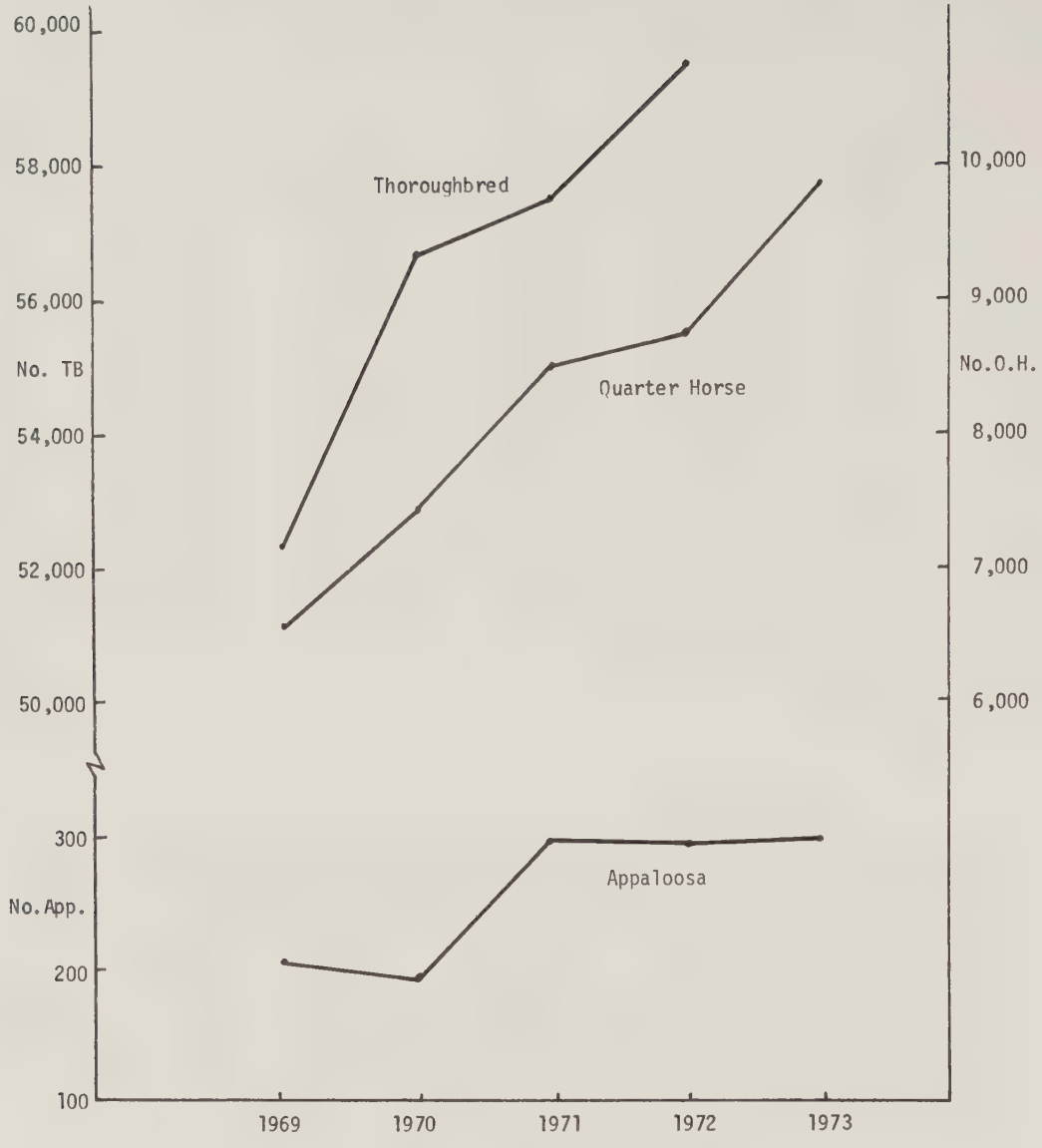


Fig. 3.—Horse races in the United States, 1969-73.

(Fig. 3. Data: Races—U.S. Total, 1969-73.)

	1969	1970	1971	1972	1973
Appaloosa	207	192	297	295	298
Quarter Horse	6,584	7,438	8,504	8,722	9,832
Standardbred		(data not available)			
Thoroughbred	52,315	56,676	57,467	59,410	

Source: Respective breed associations.

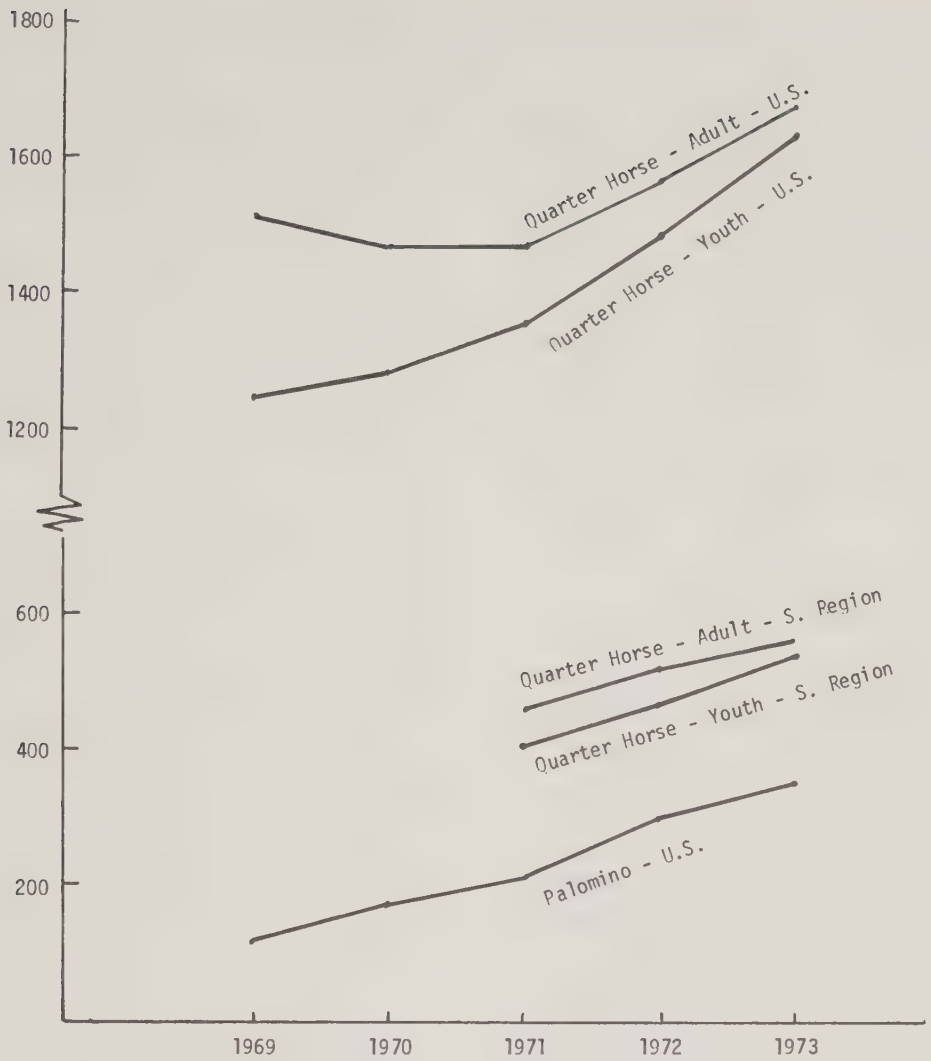


Fig. 4.—Horse shows in the United States and the Southern Region, 1969-1973.

(Fig. 4. Data: Horse Shows—U.S. total, 1969-73.)

	1969	1970	1971	1972	1973
Palomino	120	174	212	300	357
Quarter Horse, adult—U.S.	1,519	1,476	1,480	1,581	1,690
Quarter Horse, youth—U.S.	1,252	1,290	1,361	1,498	1,652
Quarter Horse, adult—S. Region			461	520	562
Quarter Horse, youth—S. Region			407	473	541

Source: Respective breed associations.

RESEARCH PERSPECTIVES

Research on biological factors influencing horse production was curtailed in the 1930's and 1940's owing to the reduced reliance on the horse for transportation and power. Research on horses was essentially nonexistent for more than 20 years; however, in the late 1960's equine research gradually increased in response to the increasing popularity of the horse as an animal used in the recreation industry. Since the moratorium on horse research occurred during a time when great strides were made with other domestic species, research for the horse industry has considerable catching up to do. Nevertheless, funds for equine research are very limited.

Little supportable argument can be offered to refute the claim that disease represents an annual cost, by loss of use and mortality of horses, of many millions of dollars as well as in unmeasurable disappointment to owners. Losses from infectious and non-infectious disease, lamenesses and unsoundnesses, and parasitism as well as from lack of basic knowledge of reproductive physiology and nutritional requirements are well appreciated by anyone who owns or attempts to breed horses. A well accepted estimate of probable success in breeding horses is that one must breed three mares if he is to get one yearling either in the hands of a trainer or to the sales pavilion. A major portion of the attrition of fond expectation represented by this estimate is due to problems for which solutions are predictably realizable through applied research. Also, the need for basic research in the biology of the horse, which is in many respects unique, is very great.

During the past 40 years, funds approaching an adequate investment in research designed to improve the health of horses have become available only after the occurrences of "scare" diseases such as equine influenza, equine infectious anemia and most recently, Venezuelan encephalomyelitis. Because the horse is not regarded as an important food or fiber-producing animal, public funds have not become readily available until, as in the case of arboviral encephalitis, the public health becomes a consideration. Although expenditure of funds in these emergency situations is certainly justifiable, allocation of funds on a continuing basis to research organizations attempting to solve the many, perhaps less dramatically apparent but tremendously costly problems, is a more reasonable approach to supporting the needs of the horse industry.

Broadly speaking, the problem category areas for which research is badly needed and could be conducted in various disciplines in the Agricultural Experiment Stations are: (1) infectious diseases, (2) basic studies of the immunology of equine diseases, (3) research to define the nutritional requirements for horses during development, for performance and for reproduction, (4) research to describe the physiology of reproduction in both stallions and mares, (5) study of the pharmacology of drug action and effects in horses, (6) investigations designed to develop treatment and control regimens for internal parasitisms and for the control of ectoparasites, (7) research on pastures and forage for horses under varying climatic conditions, (8) study of land use planning and housing for horses, and (9) research in metabolic and genetically conditioned diseases of horses.

The dynamic growth of the horse industry of the United States has resulted in a very appreciable increase in the contribution of the horse industry to both the economy of this country and the recreational opportunities of its people. Problems, recognized to limit the growth and quality production of horses, have certainly become appropriate subjects for research designed to support the total agricultural economy. These needs are summarized in the table on page .

SUMMARY OF SCIENTIFIC MAN YEAR (SMY) ALLOCATIONS TO HORSE RESEARCH PROBLEM AREAS (RPA) BY STATE AGRICULTURAL EXPERIMENT STATIONS AND THE USDA IN THE SOUTHERN REGION

RPA[1]		SMY			
		1973 Allocation[2]		Proposed Allocation for Southern Region	
Number	Name	National	So. Region	With Limited Increase[3]	To Solve Problems within 10 Yr.[4]
210	Insect Pests	1.7	1.2	1.2	3.5
211	Diseases	16.3	8.3	9.0	17.0
212	Internal Parasites	6.1	4.6	4.6	7.0
213	Toxic Chemicals	—	—	*	4.0
310	Reproduction	2.2	1.6	2.3	6.0
311	Biological Efficiency	6.0	3.4	4.0	(10.5)
	Nutrition				4.5
	Breeding				2.0
	Exercise Physiology				2.0
	Behavior and Training				2.0
312	Environmental Stress	0.4	0.1	0.1	1.5
313	Management Systems		—	*	1.5
317	Mechanization and Structures		—	*	1.5
506	Prices, Marketing and Operations	0.1	—	*	3.0
901	Waste Management		—	*	3.0
	Total	32.8	19.2	21.2	58.5

[1]As identified and further described in MANUAL OF CLASSIFICATION of AGRICULTURAL AND FORESTRY RESEARCH (revision 2, Jan. 1973), issued by Science and Education Staff, USDA, Washington, D. C.

[2]SMY's reported for 1973 obtained from information retrievals from the Current Research Information System (CRIS).

[3]Proposed allocation of SMY's with limited increase were made within restrictions of 10 percent increase over 1973 level for the Southern Region. The Task Force recognized the needs for research in all of these RPA's including high priority assessment of those RPA's marked with an asterisk (*) to which no SMY allocations were made at this limited increase level. Within the SMY restraints imposed, the support level was considered to be inadequate to initiate immediately needed research in these RPA's.

[4]This proposed allocation of SMY's represents an estimate of the support level required to expand and continue high priority horse research needs and to initiate needed new areas of horse research in the Southern Region.

CONTROL OF INSECT AND OTHER ARTHROPOD PESTS OF HORSES

RPA 210

SITUATION:

In the Southern Region, horses are subject to attack by a large variety of arthropod pests. Many of the pests that attack cattle will also attack horses. Biting flies (including stable flies), horse flies, mosquitoes, gnats, and others suck blood from horses, may transmit diseases such as equine encephalitis, and in certain instances may cause the death of horses. A non-biting fly, the face fly, is a source of considerable annoyance to horses because it feeds around the eyes, nostrils and lips of horses. A number of ticks parasitize horses. Winter ticks are often found in large numbers and may cause an edematous condition known as "water belly." The Gulf Coast tick may infest the ears of horses and destroy cartilage, causing a condition known as "goch ear." The tropical horse tick that lives in the ears, nostrils and mane of horses can transovarially transmit equine babesiosis. Other ticks, such as the spinose ear tick, lone star tick, and American dog tick, can be found on horses. Horses are attacked by two species of horse bots that spend considerable time as larvae in the stomach of horses. Infestations by these bots may lead to ulcerous conditions in the horse's stomach, and the annoyance of the egg-laying activities of the adult flies is of potential danger to the horse and rider. Horses are also infested with biting lice, sucking lice, mange mites, and can be victims of myiasis-producing flies such as the screw worm.

Generally, horses can be divided into two groups: pleasure horses, those that are used for activities such as entertainment, racing, showing; and working horses, those that are used in ranching activities. Pleasure horses may be highly cared for and under the constant surveillance of humans, but they also may be completely neglected. In general, working horses are cared for to the extent that they may be in condition to work for the rancher as needed in his ranching activities. In both cases there is a need for control of arthropod pests. Unfortunately, few insecticides are available for application to horses. For example, Texas A&M University Extension Service pamphlet MP-691 (1974) lists three insecticides that are applied to horses for the control of lice, horn flies and ticks and two insecticides that are applied to horses orally for the control of horse bots. Although a considerable amount of information has been accumulated on a number of products that can be applied to beef cattle and dairy cattle for the control of ectoparasites, little information has been accumulated on the effectiveness of these products for the control of ectoparasites of horses. A glaring need is the lack of a suitable repellent for biting flies. Most horses kept in confinement, such as in corrals and pens, are continually bothered by stable flies, horse flies, gnats and other flies. There is a need for a product that will prevent these flies from feeding and causing irritation in horses.

There is also a need for systemics that can be administered in the feed of horses that will circulate through the system of these horses and kill ticks and other ectoparasites that are sucking blood from the animals. Such a treatment is highly desirable for the control of the tropical horse tick, which spends much of its life in the nasal diverticulae and the ears of horses. There is also a need to find new methods of applying insecticides to horses. Present methods include spraying, dipping and dusting. Often these techniques cause a severe reaction on the part of the horses to avoid the liquid or dust. If self-treatment applications or techniques that would allow for the treatment of animals without the accompanying excitation could be developed, more horses could be treated in a safer manner. Little information is available on the effect that arthropod pests have on the reproduction, physical condition and well-being of horses. Certain obvious situations, such as death of debilitation, can be traced to infestations of arthropod pests, but the chronic effects of sub-lethal infestations have not been elucidated. There is no accurate information on the losses experienced by horse owners because of arthropod pests.

OBJECTIVE:

To provide information on the biology and control of arthropod pests of horses.

RESEARCHABLE PROBLEMS:

A. Obtain additional information in the laboratory and in the field on the biology and ecology of arthropod pests of horses.

B. Develop methods of chemical control of arthropod pests of horses.

C. Find materials that will repel biting flies from horses.

D. Develop techniques and procedures to determine the effect that arthropod pests have on the performance, growth, longevity and reproduction of horses.

POTENTIAL BENEFITS:

Through knowledge of the biology, life history, ecology and seasonal appearance of arthropod pests of horses, horse owners will be able to use insecticides and repellents more intelligently to achieve maximum benefit from the treatments. Through the development of new pesticides, including insecticides and repellents, the horse owner will be able to treat his horses and prevent the irritation, blood loss and diseases that result from the infestations of flies, ticks, lice, bots and other arthropod parasites. Because of the often highly emotional relationship horse owners have with their horses, the ability to control these ectoparasites will allow horse owners to feel that they are able to provide an arthropod parasite-free existence for their animals. In addition, horses not infested with ectoparasites, bots and diseases will be able to function better in their roles as pleasure riding horses or as working horses on ranches. The development of self-application methods or other methods of application that do not frighten horses will allow treatment of ectoparasites without the danger of injury to the horses or to the applicators, and finally a knowledge of the effects that ectoparasites and bots have on the well-being of horses will allow horse owners to better determine the need for the treatment of these arthropod pests.

DEVELOPMENT OF METHODS FOR DIAGNOSIS, TREATMENT, PREVENTION AND CONTROL OF DISEASES OF HORSES

RPA 211

SITUATION:

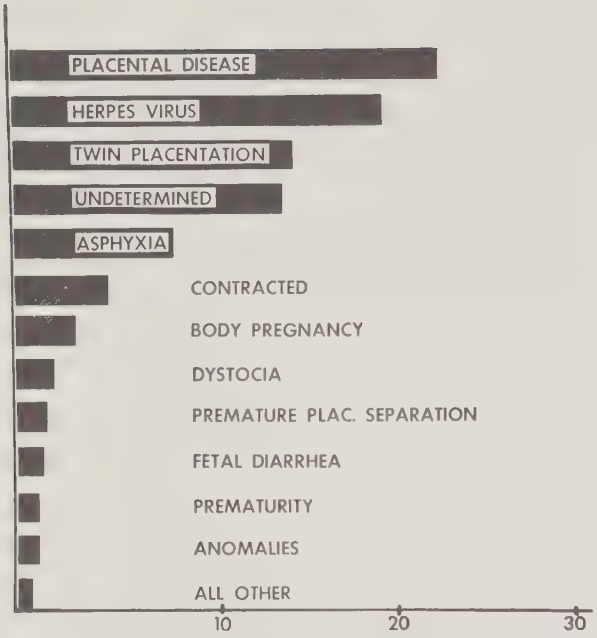
One of the most significant factors limiting the efficiency of horse production and the use of horses is infectious disease (Fig. 5). The infections of primary significance in reproductive performance are the viral infections of pregnant mares that produce abortion or result in neonatal disease of foals and the bacterial and mycotic infections of the reproductive system of mares that compromise fertility. During foal's first year of life, both bacterial and viral infections limit their development, destroy their future utility as performing animals, or result in loss by death. After the first year, respiratory viral infections and their sequellae become the diseases of primary importance. The epidemiology of those viral diseases for which etiology has been defined requires intensive investigation to provide efficient methods for control.

While research has provided information applicable to control of a number of viral and bacterial diseases of the horse, several diseases recognizable as syndromes of unknown etiology remain for investigation. Certain of the diseases in the latter category may be metabolic in origin or associated with specific feeding regimens. These are a subject for investigation requiring collaborative effort by pathologists, biochemists, nutritionists and microbiologists. A number of disease syndromes affecting foals and performing horses which present signs suggestive of viral etiology deserve the attention of virologists, pathologists, bacteriologists and veterinary clinicians. Chronic respiratory disease of performing horses is a problem for which little pertinently applicable information is available.

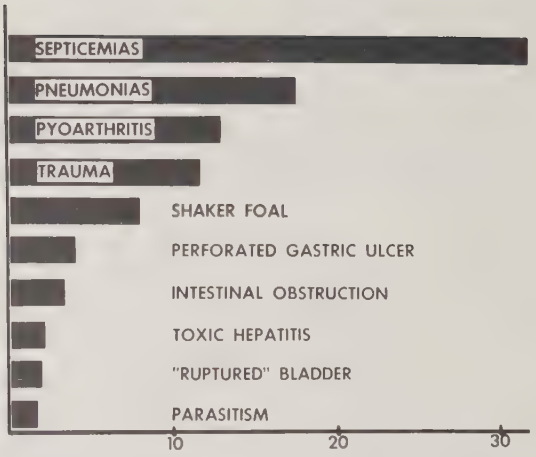
In regard to development of systems for control of many infectious diseases, definition of the role of the immune response at both the humoral and cellular levels in resistance and in pathogenesis deserves attention. The results of research to define the immune response would become applicable to objective evaluation of the utility of candidate vaccines through definition by *in vitro techniques of serviceable* immune responses to infectious agents and vaccines produced with them. There is also a need for basic bacteriologic research designed to define the antigenic characteristics, pathologic importance, epidemiology and mechanisms of pathogenesis of bacterial infections which produce primary or secondary disease of the horse.

OBJECTIVE:

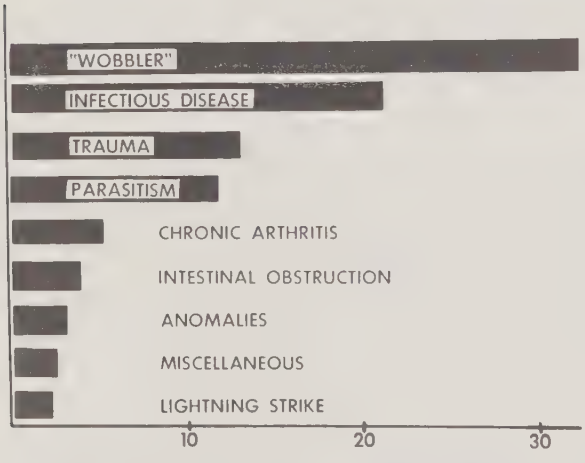
To ameliorate the effects of infectious diseases on horse production and utility.



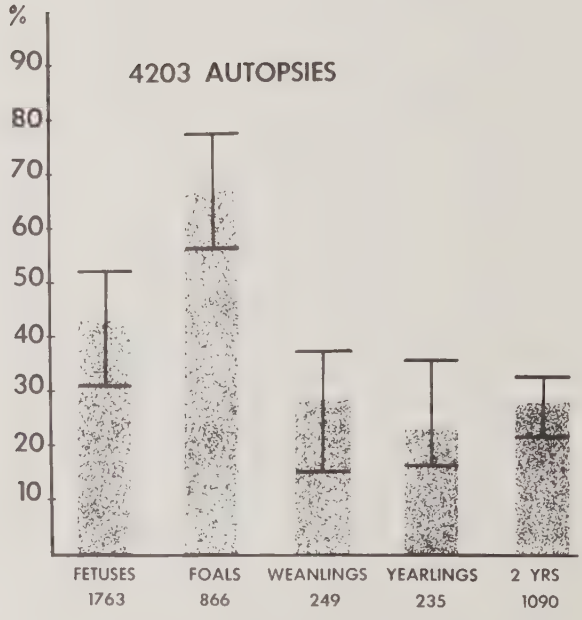
FETAL WASTAGE–% OF 1,773 FETUSES



CAUSES OF MORTALITY OF FOALS–BIRTH TO 5 MONTHS OF AGE–% OF 771 AUTOPSIES



CAUSES OF MORTALITY OF WEANLINGS AND YEARLINGS–% OF 473 AUTOPSIES



INFECTIOUS DISEASE MORTALITY

Fig. 5.—Observations on equine infectious diseases. (Data from records of the Department of Veterinary Science, Kentucky Agricultural Experiment Station.)

RESEARCHABLE PROBLEMS:

A. The herpesviruses of the horse represent one of the most significant threats to fetuses, foals, race horses and broodmares. Study of the virology, including antigenic structure and interrelationships, of pathogenesis and epidemiology with specific reference to definition of the carrier state, the immune response in terms of both humoral and cell-mediated factors and development of objective criteria for definition of the immune state for the abortigenic types of virus need to be accomplished if an efficient and safe method for control is to be obtained. The pathogenesis of cytomegalo-like equine herpesviruses requires intensive study to define their role in disease.

B. A prospective virological and serological study of undefined respiratory and systemic diseases of the horse presenting signs suggestive of viral etiology should provide a basis for assigning research priorities. Infections of this nature are especially prevalent in foals and in horses during their early performing years.

C. Study of specific bacterial infections of foals to develop treatment and control methods is needed. Among the diseases that are definite problems are *Corynebacterium equi* infections, Salmonellosis, acute bacterial hepatitis, streptococcal infections, and acute toxicosis of foals produced by anaerobes under specific feeding regimens.

D. A study of the role of adenoviruses and rhinoviral types with the initial objectives of defining clinical, virologic and pathologic aspects of disease known to be produced by these viruses and the ultimate objectives of providing systems for control should be instituted.

E. A reference laboratory that can monitor antigenic changes in the equine influenza viruses and provide information needed to maintain protective potency of vaccines needs to be established.

F. For equine infectious anemia, research to define relative infectivity for insects of carrier horses, investigate the effects of antigenic modulation of the virus and develop immunoprophylactic measures to control the disease in endemic areas is required.

G. In regard to need for research in the basic biology of the horse, research is needed to characterize fully its immunoglobulin species and describe the functions of specific proteins in the humoral and cell-mediated immune response. The role of cell-mediated immune responses to specific agents, notably the viruses that infect horses, needs definition as a basis for developing efficient vaccines.

H. In regard to noninfectious diseases, there is a need for research to define the cause of diseases suspected to be of genetic and/or metabolic origin. These include congenital malformations (see also RPA 213) and immunodeficiency diseases. A study of the cytogenetics of horses, coupled with genetic analysis providable by work with serum proteins, may yield information applicable to control of such disease. Few diseases of apparent metabolic origin are recognized to affect horses. Among the problems in this area that are recognized to be economically significant is the defective neuromuscular transmission syndrome recognized in foals in Kentucky.

POTENTIAL BENEFITS:

The problem areas outlined represent a priority group estimate of the economically most important problems believed amenable to solution by basic or applied research within the estimable limits of research resources that may be assignable. The benefits to be derived from the achievement of objectives defined by individual research projects within the subject areas are obviously those associated with limitation of loss and improvement of the quality of production of horses.

DEVELOPMENT OF METHODS OF MINIMIZING INFECTIONS, EFFICACIOUS TREATMENT AND CONTROL OF INTERNAL PARASITES OF THE HORSE

RPA 212

SITUATION:

Internal parasites of the equine cause economic losses that are presently unestimatable. Foals are born free of parasites, and internal parasites do not multiply within the body; however, every horse becomes infected with one or more of the common internal parasites and the injury varies from benign, inapparent effects to fulmination injury that may cause death. Overstocking, overgrazing and mixing of all ages of horses are common management practices that enhance parasitic infections. Young animals are

especially susceptible to infections of internal parasites whose common manifestations, i.e., low feed utilization, poor growth rate, debilitation, or death are usually displayed in the immature segment of the host population.

Contemporary treatment and control measures for most of the pathobiologic effects of the internal parasites are cumbersome, costly and limited in scope.

OBJECTIVE:

To elucidate the biological interrelationships between the internal parasites and their host and to improve prophylactic methodology.

RESEARCHABLE PROBLEMS:

A. Study factors affecting transmission and pathogenesis of specific parasites.

B. Investigate physiology and toxicology of parasitic entities by *in vitro* and *in vivo* methodologies.

C. Determine feasibility of immunologic and radiobiologic methods of control.

D. Evaluate chemotherapeutic and chemoprophylactic efficacy of anthelmintic drugs.

E. Study biological methods of control, with emphasis on natural pathogens and management practices.

POTENTIAL BENEFITS:

Derivation of a thorough understanding of the inter- and intra-specific factors affecting the biological inter-relationships between these internal parasites and their hosts will provide an assessment of their pathogenic potentials as monospecific or polyspecific infections.

Determination of the efficacy of the chemotherapeutic, immunologic and biologic approaches to control will elucidate relative feasibilities and values. This may also permit synergistic and complementary approaches to the prophylaxis and control of these complex disease-producing entities.

PROTECTION OF HORSES FROM NATURAL AND SYNTHETIC POISONS

RPA 213

SITUATION:

Horses are poisoned acutely by a variety of synthetic and natural poisons. There appears to be little priority need for research on acute chemical poisonings except to define the potential hazard of substances of that nature with which horses are placed in contact. The toxicity for horses of herbicides used on pasture and forage crops may require attention to define relationships of such compounds to teratologic effects of their ingestion by pregnant broodmares. Records of the Department of Veterinary Science, Kentucky Agricultural Experiment Station, indicate an alarming increase in incidence of congenital anomalies in purebred foals. Although the cause of this is not known, both natural (plant alkaloids) and synthetic (medications) compounds, as well as infectious processes to which the developing fetus is exposed, may be responsible. Except for sporadic Crotolaria and Senecio species plant poisonings of horses in the Southeastern United States, poisonous plants do not represent an appreciable economic problem.

A problem of significant economic importance is posed by the use of drugs in horses. The problem involves, so far as the breeding industry is concerned, undefined possible side effects of drugs on the future reproductive performance of horses. The problem for the horse industry is to control the use of medications that influence deleteriously or provide an advantage in performance over the horse's natural capacity.

The development of systems for effective control of use for such medications is an acute problem connected with maintaining public confidence in the conduct of horse activities. There is, therefore, a need for study of the exercise physiology of horses and of the pharmacokinetics of drugs which may be used to influence their performance activities.

OBJECTIVES:

To prevent losses in production of horses caused by natural and synthetic poisons. To provide information necessary for the objective evaluation of the effects of drugs on performance.

RESEARCHABLE PROBLEMS:

A. Study by anatomical, histologic and cytogenetic methods, malformed fetuses and foals to classify the abnormal structures presented by such specimens submitted for necropsy. Attempt to correlate histories of medications, infections or forage types given to pregnant mares with the occurrence of malformed fetuses or foals. Experi-

mentally apply suspect teratogenic compounds to pregnant mares in an attempt to reproduce specific anomalies.

B. Develop systems to assess the capacity of drugs to affect the performance capabilities of racing or performing horses. Study the pharmacokinetics of specific drugs in horses. Develop analytical techniques that may be applied to detect minimally effective doses of drugs administered to horses to affect performance.

POTENTIAL BENEFITS:

Description of a teratogenic effect of a chemical compound or plant poison given or ingested by broodmares would allow breeders to avoid contact of their mares with the inciting cause of malformed fetuses and foals.

Research on the pharmacology of drugs used in performing animals would provide for officials charged with supervision of racing, shows and other competitive events in which horses participate, information to objectively promulgate enforceable rules to govern medications. Attainment of this objective would serve to maintain public confidence in the conduct of horse sporting events and protect horses from the deleterious influences of harmful drugs.

IMPROVING REPRODUCTIVE EFFICIENCY IN HORSES

RPA 310

SITUATION:

Reproductive efficiency in horses cannot be well documented. Informed sources, however, place the average conception rate at 60 to 70% and the foal crop at 50 to 60%. Well managed breeding establishments will normally exceed these figures but, on a comparable management basis, the horse has the lowest reproductive efficiency of any of the domestic species. Although studies on the mechanisms by which reproduction is controlled in laboratory animals, swine, sheep and cattle has application to the horse, only the mare and the ewe are seasonal breeders among our domestic species. Even these two have marked differences since the ewe is a short-day breeder and the mare a long-day breeder.

A portion of our problems with reproduction in the horse concerns breeding management systems. A stallion in a pasture with a group of mares will normally achieve a greater reproductive efficiency than hand-mating the same animals, although scientific proof of this observation is not available. However, the potential for injury to valuable stock is greatly increased by this system and, therefore, a relatively high percentage of the better horses are hand-mated.

Much of the low reproductive performance in horses can be attributed to a high degree of variability in the reproductive cycle of the mare and the inability of the breeder to identify consistently the optimum time for insemination. Variability in the cycle is closely related to the mares' complex hormonal system. A better knowledge of the neural and humoral factors controlling estrus and ovulation is essential to improved reproductive performance.

Other factors contributing to low reproductive efficiency include early embryonic mortality, low fertility of stallions, reproductive tract infections and nutritional inadequacy.

OBJECTIVE:

To improve reproductive efficiency of horses.

RESEARCHABLE PROBLEMS:

A. Establish the relationship between the neural and the humoral factors which control the reproductive functions of the mare.

B. Develop methods for accurately detecting estrus and predicting the time of ovulation.

C. Identify and quantitate the environmental factors influencing reproduction in the horse including: nutrition, light and weather.

D. Develop methods for the detection, treatment and prevention of reproductive tract infections in the mare and stallion.

E. Semen evaluation and factors influencing the production of quality semen by the horse.

F. Factors influencing fertilization, ova development, embryonic mortality and abortion in mares.

G. Artificial insemination in horses including semen extenders and freezing semen.

POTENTIAL BENEFITS:

An increased knowledge of the factors influencing the reproductive cycle of the mare would

permit the breeder to:

a) select against metabolic abnormalities detrimental to reproduction,

b) manipulate those factors which are controllable for improved reproductive efficiency, and

c) control the cycles of the mare, thereby adjusting the breeding season to the most desirable time, reducing the problem of predicting time of ovulation, increasing the number of mares bred to each stallion and grouping the foal crop.

An increased understanding of the factors which influence conception and embryonic development, including infections of the reproductive tract, should help the horseman and his veterinarian reduce false pregnancies and embryonic mortality.

Improved semen evaluation techniques will allow the horseman to selectively breed to stallions with high fertility potentials. This would greatly improve the likelihood that a sound mare would settle.

The increased use of artificial insemination would permit the use of superior stallions over a large number of mares. This could greatly increase the quality of horses produced.

IMPROVING BIOLOGICAL EFFICIENCY IN HORSES

RPA 311

Exercise Physiology in Horses

SITUATION:

Horses are used for a variety of athletic purposes including both competitive and non-competitive activities. Obviously, physical conditioning for these activities is a predetermining factor in success or failure of performing horses. There is little research information on exercise physiology in horses. Consequently, horses are trained for athletic competition by very subjective means, and criteria for objectively determining performance ability are badly needed. Horses are fed diets during performance training that have no scientific justification. Information is needed for accurately formulating rations for athletic performance.

OBJECTIVE:

A. Develop objective criteria for determining levels of physical fitness in horses.

B. Determine specific training regimes necessary to reach and sustain measurable levels of fitness.

C. Determine relationships between nutrition and athletic performance.

RESEARCHABLE PROBLEMS:

A. Measure changes in heart and respiratory rates in horses under different intensities of exercise.

B. Determine efficiency of oxygen utilization following prescribed levels of exercise.

C. Define suitable tests of performance capabilities.

D. Determine relationships between measured physiological parameters and actual performance capability.

E. Determine effects of type of diet during training and effects of diet manipulation on physiological parameters and athletic performance.

F. Fraction out components of athletic performance based on data gathered.

POTENTIAL BENEFITS:

This research would reveal objective criteria for measuring different levels of physical fitness in horses and reduce the necessity of committing this measurement to trial and error. Therefore, horses could be trained for performance activities according to more definable criteria than is currently possible. Of major significance in these research results would be the relationships between predicted and actual performance, and nutrition. Horses can be fed rations more conducive to maximum physical performance when nutritive and non-nutritive requirements for measurable physical activity are defined.

IMPROVING BIOLOGICAL EFFICIENCY IN HORSES (continued)

RPA 311

Behavior in Horses and Psychology of Training

SITUATION:

The main trait of economic importance in the non-racing horse is behavior and learning ability.

Very little research has been reported which objectively identifies components of horse behavior or learning ability. The value of any given horse is greatly enhanced through acquisition of performance ability. Most of this acquired ability is the result of behavior modification. Objective criteria for measuring learning ability at a young age are desperately needed in order to allow concentration of resources on horses which learn quickly and efficiently. Long-term research is needed to determine relationships between learning ability and performance and the heritability of these behavioral components.

OBJECTIVE:

A. Establish criteria and conditions suitable for horse behavior research.

B. Develop objective measurements of learning ability in horses.

C. Partition learning ability into heritable and environmental components.

RESEARCHABLE PROBLEMS:

A. Develop the laboratory apparatus for measuring responses of horses to various stimuli.

B. Compare individual animals for rate of learning, using different sensory modalities.

C. Compare individual animals for discrimination learning ability, using all sensory modalities.

D. Determine effects of both positive and negative reinforcement on rate of learning and extinction.

E. From above, develop screening test for learning ability to be used at an early age.

F. Compare test results with actual performance.

G. After sufficient data have been accumulated, determine heritability of learning ability.

H. Accumulate sufficient data to completely partition performance of a horse into genetic and environmental components.

POTENTIAL BENEFITS:

Results of research in the psychology of training horses would reveal more objective methods and techniques usable in horse training. The market value and other values of a horse are greatly enhanced by the level of training the horse has received. Through use of objective methods, all horse owners could improve individual horses and, more importantly, put time and resources into those young horses which have demonstrated superior learning ability through prior tests of learning ability. The end result would be greatly enhanced efficiency of time and dollar expenditure in the process of horse training for a specific purpose.

IMPROVING BIOLOGICAL EFFICIENCY IN HORSES (continued)

RPA 311

Breeding

SITUATION:

Scientific genetic analysis of light horse breeding in the United States has largely been neglected despite the great contribution sporting type horses have made to the development of this country.

There is a real need for an overall assessment of breed structure of the various breeds of sporting type horses. Are distinct families or strains forming within various breeds? If so, are these families genetically distinct from each other in terms of performance?

The maintenance of the broodmare band is the largest single expense to a breeder. Any aid that a breeder could use to predict the producing ability of a mare early in her stud career would be of great economic importance.

OBJECTIVE:

A. Determine inbreeding trends in selected breeds since an assessment of inbreeding trends should give an indication of the extent to which family formation may be taking place.

B. Determine the correlation among the performances of the progeny of a given mare.

RESEARCHABLE PROBLEMS:

A. Determine inbreeding coefficients in selected breeds and relate inbreeding to performance traits.

B. Determine repeatability of mare productivity.

POTENTIAL BENEFITS:

The identification of superior families within a breed would make pedigree selection much more effective. Knowledge of the effects of inbreeding on performance would aid in evaluating the potential performance and breeding value of untrained horses.

An estimate of the repeatability of mare productivity could be very useful in making culling decisions. When repeatability is high and is used in conjunction with a measure of the average productivity of a mare, her most probable producing ability can be determined relatively early in her stud career.

IMPROVING BIOLOGICAL EFFICIENCY IN HORSES (continued)

RPA 311

Nutrition

SITUATION:

Horsemen spend more for feed than for any other single factor relating to the maintenance of their animals. Ample portions of high quality grains and forages provide most of the nutrients needed for the maintenance of horses. However, growing foals, broodmares and performance horses have increased requirements which necessitate supplementation with other sources of nutrients. High grain costs also make alternate ingredients such as by-products attractive. Variability in the nutrient content of ingredients makes balancing rations essential to the well-being of the animal.

The horse requires dietary sources of at least 30 different nutrients. Specific requirements have been established for only five or six nutrients for some types of horses under specific conditions. Considerable research is needed to define nutrient requirements of horses and their activities and to develop suitable, economical feeding programs.

OBJECTIVE:

To determine the nutrient requirements of the horse under a variety of different conditions and to develop feeding programs suitable for meeting these needs in all areas of the Southern Region.

RESEARCHABLE PROBLEMS:

A. Physiology of digestion in the horse to identify how the horse digests and absorbs the nutrients consumed.

B. Determine the requirements for and the interrelationship between energy, protein, fat, minerals, and vitamins for proper maintenance, growth, reproduction and performance by the horse.

C. Evaluate ingredients available in the Southern Region for use in horse rations, including grain crops, forages and by-products.

D. Evaluate processing techniques and feeding systems to increase efficiency of feeding horses.

POTENTIAL BENEFITS:

Established nutrient requirements for various activities will take horse feeding out of the "dark ages" and into the scientific area. This will result in improved performance, increased durability and a general reduction in feed costs. Increased use of locally available ingredients will reduce the dependence on imported horse feeds and should save Southern Region horsemen millions of dollars. Feed processing also offers a potential for increased feed efficiency and greater flexibility of ingredients. With the increased competition for feed grains in the future, maximum use of forages and by-products may be essential for horse production. The feed bill for horses in the Southern Region probably exceeds seven hundred million dollars per year. A reduction in feed costs of only 5% would save horse owners $35,000,000 each year.

REDUCING ENVIRONMENTAL STRESS IN HORSES

RPA 312

SITUATION:

Horses are subjected to a wide variety of environmental conditions. Some are confined to pastures with little or no protection from the elements, while others are stalled, blanketed and generally protected from weather extremes. Although many facilities are designed more for the horseman than the horse, there is a great need for information on the influence of the physical environment on the health and development of horses.

The environmental aspects of facility design are extremely important. Ventilation, temperature and humidity control, and noise should all be considered. Construction materials directly affecting the horse, such as stall floors, should be evaluated.

OBJECTIVE:

To determine the effects of various physical environmental parameters on horse health and production and to develop criteria for improved facilities.

RESEARCHABLE PROBLEMS:

A. Determine the physiological reactions of horses to temperature, humidity, ventilation and noise.

B. Develop design criteria for horse facilities which provide suitable environmental protection at acceptable prices.

C. Determine the material requirements for "safe" horse facilities and evaluate various flooring alternatives.

POTENTIAL BENEFITS:

Information obtained from research in the foregoing areas will enhance the structural design for housing and the use of horses in high density situations. Many new housing developments are currently allocating space for equestrian centers where horses will be boarded and used. These developments must use all available technology to minimize complications from odor and refuse, and must be designed for minimum labor requirements. These potential research results will allow development of such centers in a fashion compatible with environmental requirements and the health and longevity of horses.

IMPROVING PRODUCTION MANAGEMENT SYSTEMS FOR HORSES

RPA 313

SITUATION:

Horse production management systems vary greatly with the type of horse being produced and the environmental conditions of the area. Unfortunately, factual information on the very basic factors used to make management decisions for other domestic species is almost non-existent for the horse. After a shift in location or a change in objective, a new manager frequently resorts to trial and error until a satisfactory program is derived.

Of primary importance is information on facilities for horses including buildings, equipment and fencing. Space requirements and housing techniques such as stalled vs. paddock vs. pasture need to be studied. Pasture utilization and management comparisons should include species, fertilization and rotation programs.

Manpower is of major concern to horse farms. Qualified personnel are difficult to obtain and keep. Increased efficiency in handling horses is, therefore, important.

OBJECTIVE:

To develop information on the important factors which influence horse production decisions.

RESEARCHABLE PROBLEMS:

A. Compare housing needs and facilities for horses including building types, equipment and fencing.

B. Compare dry lot vs. pasture programs for several types of horses.

C. Compare pasture management systems for horses including species, fertilization programs and rotation systems.

POTENTIAL BENEFITS:

Data on production management problems will help producers minimize costs of raising horses under a variety of situations, increase the health of the animals and improve efficiency of land use.

MECHANIZATION, STRUCTURES, AND EQUIPMENT FOR HORSES

RPA 317

SITUATION:

The increasing number of urban dwellers who own horses is bringing about a greater need for horse care facilities. These facilities must provide a wide range of services and be flexible enough to fit

the desire of individual horse owners. Research is needed to develop reliable automated feeding and watering systems, waste handling and insect control systems which will fit into the urban environment and have application to production facilities where labor availability is limited and costly.

OBJECTIVE:

To establish design parameters for automated feed handling, waste handling, watering and insect control and to test these parameters by development of operable mechanical systems.

RESEARCHABLE PROBLEMS:

A. Study patterns of feeding and care required for horse care facilities. Establish design parameter limits of time, quantities, physical properties, etc.

B. Develop systems which provide flexibility to meet the range of needs in feeding, and determine mechanical design requirements such as power use, control functions and special material durability requirements.

C. Test various automated waste handling systems to establish design requirements, performance and cost of operation.

D. Study system requirements for automated insect control in the urban horse care facility. These need to be established for the barn and lot area as well as bridle paths, arenas or other riding areas.

POTENTIAL BENEFITS:

Successful development of facilities and equipment which minimize labor input on horse farms can have a significant impact on the economics of the industry and help improve the health of horses by insuring better care.

ANALYSIS OF RECENT CHANGES IN THE SUPPLY, DEMAND AND PRICE OF SELECTED BREEDS OR TYPES OF HORSES

RPA 506

SITUATION:

Reliable forecasts of supply, demand and price are essential to efficient and orderly production and marketings. Individual producers, processors, marketing firms and final users base daily decisions on this information. Sound public and industry policy decisions are dependent on prospective changes in these factors.

In general, a price analysis is the study of past price movements and the supply and demand factors associated with them. The analysis will not only give a picture of recent prices but it will point out factors which have had an adverse or positive effect on these prices and, thus, direct attention to areas where corrective action may do the most good. It will also permit forecasting. While a great deal of these data and analyses are available for those producing, handling or using beef, dairy, poultry, feed grains and other commodities, virtually none of this information is available to horsemen. Individual horsemen do not, of course, have the resources to undertake such analyses.

OBJECTIVES:

To provide for each major breed or type of light horse:

A. At least 10 years of price data and the outline of a practical means of obtaining such data on a continuing basis.

B. An estimate of the effect of the physiological and economic factors which influence supply.

C. An estimate of the effect of changes in supply on price.

D. An estimate of the effect of personal income, demographic changes, industry earnings and related factors on demand.

E. A means to forecast short run changes in supply and demand.

RESEARCHABLE PROBLEMS:

A. Specify the variables which influence supply and demand, and their relationships.

B. Locate and obtain required data.

C. Complete the statistical analysis.

D. Interpret the results.

This approach will require the description, mathematically and diagramatically of the supply-demand system, determination of the identifiability of the relationships and an estimate of the feasibility of a simultaneous fitting of the entire system of relations.

POTENTIAL BENEFITS:

There is little question that the horse industry is a major and growing part of U.S. agriculture. While neither food nor fiber, the horse does require increasing amounts of agricultural resources, providing an alternative for land and capital, additional employment and a wider market for those supplying goods and services to the industry.

Most market breeders, breed associations and others serving the industry need and will use supply, demand and price data if it is available. Price information is made available to Thoroughbred breeders and most use it extensively. Breed associations are necessarily concerned with the impact of supply on price. Suppliers of feed supplements or saddlery, Interior Department park officials, and even veterinary colleges are examples of those who must have accurate information on supply in order to efficiently meet the demands of the industry.

HORSE FARM WASTE MANAGEMENT

RPA 901

SITUATION:

Horses cause few waste disposal problems when maintained on pastures where population density is low. Limited population density information indicates that increasing numbers of horses are moving toward the cities. Since people like to have their horses relatively close, large numbers of horses are located in and around the small towns surrounding the major metropolitan areas. Waste disposal thus is becoming a major problem.

The average horse will excrete 2.0 to 4.0% of his body weight in fresh feces or 0.75 to 1.25% of his body weight in dry feces daily. If the average horse weighs 400 kg, the Southern Region horses produce 7 to 14 million metric tons of wet feces or 2.7 to 9.0 million metric tons of dry feces per year. To this must also be added the urine and bedding used. On this basis, a 25-horse stable would be faced with disposing of about 135 metric tons of manure each year, while a race track stabling 1,500 horses may need to dispose of as much as 186 metric tons of manure each week.

Bedding is a major problem to horse owners in the Southern Region who stable their horses. If only 25% of the horses are bedded for half of the year and the bedding is used at a rate of 1 bale (20 kg) per week, the yearly bedding usage would be about 318 thousand metric tons. Primary bedding materials include straw, grass hays, tobacco stems, wood products including sawdust, shavings and bark, peanut hulls and sand. It is not unusual for bedding costs to almost equal feed costs when horses are stabled continuously.

Manure handling procedures require considerable labor input. This is particularly true when horses are housed in box stalls. Improved manure handling methods could save many thousands of man hours.

Waste utilization is or soon will be of major concern to the horse industry. Where horses are located in metropolitan areas, disposal of manure can be difficult. Spreading on land is generally the method of choice, but when available land is limited alternatives are needed.

OBJECTIVE:

To develop information which will allow the horseman to handle wastes more efficiently and economically and dispose of them in a manner which will be beneficial to the economy and not a detriment to the environment.

RESEARCHABLE PROBLEMS:

A. Bedding alternatives for stables and farms.

B. Procedures and equipment for mechanized manure handling.

C. Manure utilization procedures which minimize environmental contamination. Consideration must be given to surface and ground water nutrients and infectious organisms.

POTENTIAL BENEFITS:

Bedding alternatives and improved manure handling procedures will help reduce the costs and labor input essential to good horse management.

Improved manure utilization techniques will help the horse industry to be a better neighbor. Although in some cases, increased costs are inevitable, large facilities may find costs reduced and, perhaps, waste materials turned into economically advantageous products.

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